MTX65 – MTX63 TERMINAL

Integrators Manual

Intelligent, powerful, flexible and simple GSM Terminal in a box

Approved Partner
Wireless Modules
SIEMENS

Powered by SIEMENS WM TC63 or TC65 GSM-GPRS Wireless Module

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Important information

This technical description contains important information for start up and use of the MTX-63/65 Terminal.
Read it carefully before you start working with the MTX-63/65 Terminal.
The warranty will be void should damage occur due to non-compliance with these instructions for use.
We cannot accept any responsibility for consequential loss.

Service and Support

To contact customer support please use the contact details below:

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Alejandro Sanchez, 109
28019 Madrid –Spain-
gsmsupport@matrix.es

Information about MTX-63/65 product and accessories is available on the following web site:
http://www.matrix.es/MTX-Terminals

And following FTP server (ask for user&password access):
ftp://ftp.matrixelectronica.eu/

Or contact your local distributor / sales agent:

REVISION INFORMATION

FIRST EDITION. VERSION 1.1.	Release: JULY 2007
VERSION 1.2.	Release: 25/07/2007: Added RoHs compliant
VERSION 1.3	Release: 25/09/2007 Added MTX-Terminal logo Fixed ASC1 RD & TD signals Added Conformity Assessment
VERSION 2.0	Release: 19/11/2007 New V2 gray housing

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1. INTRODUCTION

1.1 Description

The MTX-63/65 is an intelligent GSM/GPRS control terminal that encapsulates everything you need for wireless M2M capability in one compact unit.

The MTX65 in conjunction with JAVA SDK software package can host and control your wireless application, minimizing the need for extra components.

Alternatively, it can be used as a powerful standalone GPRS modem with its intrinsic TCP/IP stack.

The MTX-63/65 is a self contained terminal with its own SIM card reader and 3 standard connectors interfaces, minimizing the need for further hardware development. This terminal can be used as a powerful and flexible device that can be used in a wide range of telemetry and telematics applications that rely on the remote exchange of data, voice, SMS or faxes via the GSM cellular network.

As well as providing a standard RS232 serial communication interface the MTX-63/65 also has an audio interface allowing an analogue handset to be connected. Also a USB port is included to allow the connectivity to all relevant PCs and control boards in office and industrial environments. The MTX65 in their expansion port has a wide and useful range of IOs that can be reconfigured to add functions and features that make your M2M solution both innovative and cost effective.

The MTX-63/65 can be used to provide a communications link for a variety of wireless applications including fleet and asset management, vending, security and alarm monitoring, e-maintenance and other telemetry applications.

With quad band 900/1800 MHz and 850/1900 MHz, your applications can be used all over the world.

The MTX63 incorporates a Siemens WM TC63 module and the MTX65 has a TC65 inside.

The MTX-63/65 terminal offers hardware compatibility with both SonyEricsson legacy GM28/29 and GT47/48 terminals, with enhanced features.

Note! Some of the functions described inside this Technical Description are only possible when the SIM-Card is inserted

1.2. ORDERING INFORMATION

MTX-65: 199801094
MTX-63: 199801092

Hardware revision: 1.5
Firmware revision:
MTX-63: 02.00
MTX-65: 02.00

1.2 Highlights

Interfaces

- FME M 50 Ohm antenna connector
- Expansion Port: 15-way HD-Dsub: **Only for MTX-65**
  - 4 Digital Input/Output
  - 2 Analog Input
  - 1 x I2C/SPI bus
  - 1 x 2-wires RS232 UART
- RS232 - 9 pin D-sub connector for serial interfaces (ITU-T V.24 protocol)
- USB mini (2.0 Full-Speed End-Point Compliant)
- Operating status LED
- SIM card interface 3 V, 1.8 V with SIM detection
- Plug-in power supply and on/off interfaces
- Handset audio interface
- VRTC + Alarm

General Features

- Quad-Band GSM 850/900/1800/1900 MHz
- GPRS multi-slot class 12
- GSM release 99
- Output power:
  - Class 4 (2 W) for EGSM850 & EGSM900
  - Class 1 (1 W) for GSM1800 & GSM1900
- Control via AT commands (Hayes 3GPP TS 27.007 and 27.005)
- SIM Application Toolkit (release 99)
- TCP/IP stack access via AT commands
- Internet Services: TCP, UDP, HTTP, FTP, SMTP, POP3
- Supply voltage range: 6 ... 30 V
- Power consumption (at 12 V):
  - Power down 0,5 mA
  - Sleep mode (registered DRX = 5) 29 mA
  - Speech mode (average) 184 mA
  - GPRS class 12 [Power reduction = 6dB] (average) 330 mA
- Temperature range
  - Operation: -30°C to +70°C
  - Storage: -40°C to +85°C
- Dimensions. Excluding connectors:78,1 x 66,8 x 37,2 mm
- Weight: < 190 g

GPRS data transmission

- GPRS class 12
- Mobile station class B
- PBCCH support
- Coding schemes CS 1-4

Multiple simultaneous PDP contexts

CSD data transmission

- Up to 14.4 kbit/s
- V.110
- Non-transparent mode
- USSD support

Specification for fax

- Group 3, class 1, 2

Voice Features

- Triple-rate codec for HR, FR, and EFR
- Adaptive multi-rate AMR
- Basic hands-free operation
- Echo cancellation
- Noise reduction

Short Message Service (SMS) Features

- Point-to-point MO and MT
- SMS cell broadcast
- Text and PDU mode

Internet Protocols

TCP/UDP/IP protocol stack
Extensive AT command access to TCP/IP stack
Internet Services: TCP, UDP, HTTP, FTP, SMTP, POP3

Open application resources (only MTX65)

ARM© Core, Blackfin© DSP
- Memory: 400 KB (RAM) and1.7 MB (Flash)
- Improved power-saving modes

Java™ features (only MTX65):

- CLDC 1.1 Hl
- J2ME™ profile IMP-NG
- Secure data transmission with HTTPS, SSL and PKI

Over-the-air update (only MTX65)

- Application SW: OTAP
- Firmware: FOTA (OMA compliant)

1.3 MTX63-65 Wireless modems in a Communication System

Figure 1 and Figure 2 illustrate the main blocks of a wireless communication system using the wireless modem. Figure 1 show the communication system when a micro-controller is used. They also show the communication principles of the system and the interface between the wireless modem and the application and Figure 2 shows the communication system when the JAVA application is embedded on the wireless modem. The definitions in the figures, as used elsewhere in this manual, are in accordance with the recommendations of 3GPP TS 27.007.

The MS (mobile station) represents the wireless modem and SIM card. The wireless modem excluding SIM card, is known as the ME (mobile equipment).

The DTE (data terminal equipment) is the controlling application. This can be either an external host or an internal embedded application.

The DCE (data circuit terminating equipment) is the serial communication interface of the MS.

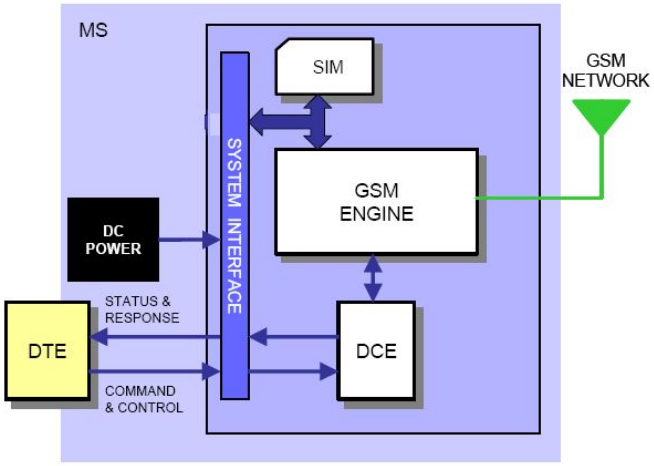


Figure 1. Main Blocks in a Wireless System (external micro-controller)

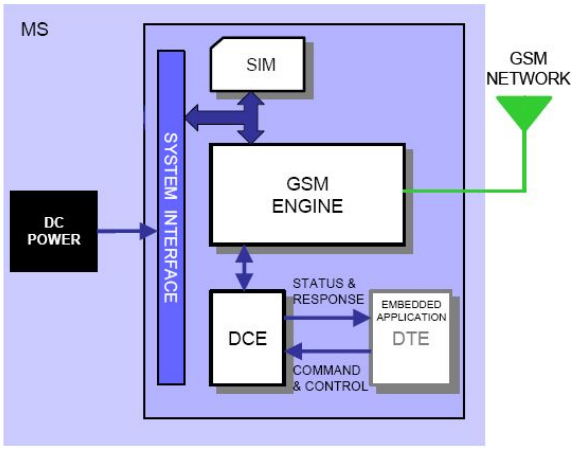


Figure 2. Main Blocks in a Wireless System (embedded application)

1.4 Main Features and Services

The MTX-63/65 performs a set of telecom services (TS) according to GSM standard phase 2+, ETSI and ITU-T. The services and functions of the MTX-63/65 are implemented by issuing customized applications embedded on the device, or by AT commands issued internally, or over the RS232 serial interface.

1.4.1 Types of Mobile Station

The MTX-63/65 is a fully Quad Band capable GSM/GPRS mobile station with the characteristics shown in the table below.

Feature		GSM850	E-GSM900	GSM1800	GSM1900
Frequency range (MHz)	Tx	824-849	880-915	1710-1785	1850-1910
	Rx	869-894	925-960	1805-1880	1930-1990
RF power @ARP with 50Ω load (typ)		33dBm	33dBm	30dBm	30dBm
Channel spacing		200kHz	200kHz	200kHz	200kHz
Number of channels		124	174	374	299
Number of TD slots		8	8	8	8
Duplex spacing		45MHz	45MHz	95MHz	80MHz
GSM power class		4 (2W)	4 (2W)	1 (1W)	1 (1W)
Modulation		GMSK			
Receive sensitivity		<-102dBm at antenna connector			
GPRS multi-slot class		Class 12			

1.4.2 Short Message Service

The wireless modem supports the following SMS services:

• Sending; MO (mobile-originated) with both PDU (protocol data unit) and text mode supported
• Receiving; MT (mobile-terminated) with both PDU and text mode supported
• CBM (cell broadcast message); a service in which a message is sent to all subscribers located in one or more specific cells in the GSM network (for example, traffic reports)
• SMS status report according to 3GPP TS 23.40

The maximum length of a text mode SMS message is 160 characters using 7-bit encoding. The wireless modem supports up to six concatenated messages to extend this function. Concatenation is performed by the host application.

1.4.3 Voice Calls

The wireless modem offers the capability of MO (mobile originated) and MT (mobile terminated) voice calls, as well as supporting emergency calls. Multi-party, call waiting and call divert features are available. Some of these features are network operator specific.

For the inter-connection of audio, the wireless modem offers balanced analogue input and output lines. The wireless modems support HR, FR, EFR and AMR vocoders.

1.4.4 Data

The wireless modem supports the following data protocols:

• GPRS (General Packet Radio Service)
The wireless modem is a Class B terminal. The wireless modem is GPRS multi-slot class10 (4+2) enabled, capable of receiving at a maximum of four timeslots per frame (down link), and transmitting in two timeslots per frame (up link). See section 1.4.5 for multi-slot allocation by class.

• CSD (Circuit Switched Data)
The MTX-63/65 wireless modem is capable of establishing a CSD communication at 9.6 kbps and 14,4 kbps over the air.

1.4.5 GPRS Multi-Slot Support

GSM Multi-slot classes supported by MTX-63/65

Multislot Class	*Maximum slot allocation*			*Allowable Configuration*	*Max data rate*
	Downlink	*Uplink*	*Active*		
8	4	1	5	1 up; 4 down	8-12Kbps Send 32-48Kbps Receive
10	4	2	5	1 up; 4 down	8-12Kbps Send 32-48Kbps Receive
				2 up; 3 down	16-24Kbps Send 24-36Kbps Receive
12	4	4	5	1 up 4 down 2 up 3 down 3 up 2 down 4 up 1 down	8-12kpbs per slot

1.4.6 Power Consumption

The table below briefly summarizes the various operating modes referred to in the following chapters.

Normal operation	GSM / GPRS SLEEP	Various power save modes set with AT+CFUN command. Software is active to minimum extent. If the Terminal was registered to the GSM network in IDLE mode, it is registered and paging with the BTS in SLEEP mode, too. Power saving can be chosen at different levels: The NON-CYCLIC SLEEP mode (AT+CFUN=0) disables the AT interface. The CYCLIC SLEEP modes AT+CFUN=7 and 9 alternately activate and deactivate the AT interfaces to allow permanent access to all AT commands.
	GSM IDLE	Software is active. Once registered to the GSM network paging with BTS is carried out. The Terminal is ready to send and receive.
	GSM TALK	Connection between two subscribers is in progress. Power consumption depends on network coverage individual settings, such as DTX off/on, FR/EFR/HR, hopping sequences, antenna.
	GPRS IDLE	Terminal is ready for GPRS data transfer, but no data is currently sent or received. Power consumption depends on network settings and GPRS configuration (e.g. multislot settings).
	GPRS DATA	GPRS data transfer in progress. Power consumption depends on network settings (e.g. power control level), uplink / downlink data rates, GPRS configuration (e.g. used multislot settings) and reduction of maximum output power.
POWER DOWN	Normal shutdown after sending the AT^SMSO command, after pressing the ON/OFF key or after the activation of the ONOFF line. The RTC works continuously, but the software is not active. Interfaces are not accessible.	
Airplane mode	Airplane mode shuts down the radio part, causes the Terminal to log off from the GSM/GPRS network and disables all AT commands whose execution requires a radio connection. Airplane mode can be controlled by the AT commands AT^SCFG and AT+CALA: With AT^SCFG= MEopMode/Airplane/OnStart the Terminal can be configured to enter the Airplane mode each time when switched on or reset. The parameter AT^SCFG=MEopMode/Airplane can be used to switch back and forth between Normal mode and Airplane mode any time during operation. Setting an alarm time with AT+CALA followed by AT^SMSO wakes the module up into Airplane mode at the scheduled time.	

Average power consumption

Parameter	Description	Conditions		Min	Typ	Max	Unit
VPOWER	Operating Voltage	for one minute		8 5	12	30	V
						33	V
IPOWER Average supply current (average time 3 min.) @25°C @ worst case: GSM 900 max power level		Power Down mode	@8V		0.45		mA
			@12V		0.50		
			@30V		0.80		
		SLEEP mode	@8V		40		mA
			@12V		29		
			@30V		18		
		IDLE mode	@8V		50		mA
			@12V		36		
			@30V		21		
		TALK mode	@8V		277		mA
			@12V		184		
			@30V		82		
		Data GPRS 1Tx / 4Rx	@8V		260		mA
			@12V		173		
			@30V		77		
		Data GPRS 2Tx / 3Rx (Power reduction = 3dB)	@8V		378		mA
			@12V		248		
			@30V		108		
		Data GPRS 4Tx / 1Rx (Power reduction = 6dB)	@8V		500		mA
			@12V		330		
			@30V		140		
IPOWER_P (6)	Peak supply current during transmission slot (577µs * No. of Tx every 4.6ms)	Power control level for Pout max	@8V		1500		mA
			@12V		910		
			@30V		340		

The power consumption figures shown represent typical average current and making different multi-slot configurations, the worst case being that of two uplink and three downlink slots.

(6) Typical values measured with antenna impedance = 50Ohm (return loss >20dB)

1.4.7 SIM Card

The MTX-63/65 supports an external SIM card through the integrated SIM holder. Both 3V and 1.8V SIM technology is supported. Older, 5V SIM technology is not supported

1.5 Precautions

The MTX-63/65 as a standalone item is designed for indoor use only. To use outdoors it must be integrated into a weatherproof enclosure. Do not exceed the environmental and electrical limits as specified in "Technical Data", page 32.

2. MECHANICAL DESCRIPTION

2.1 Overview

The pictures below show the mechanical design of the module along with the positions of the different connectors and mounting holes. The module case is made of durable PC/ABS plastic.

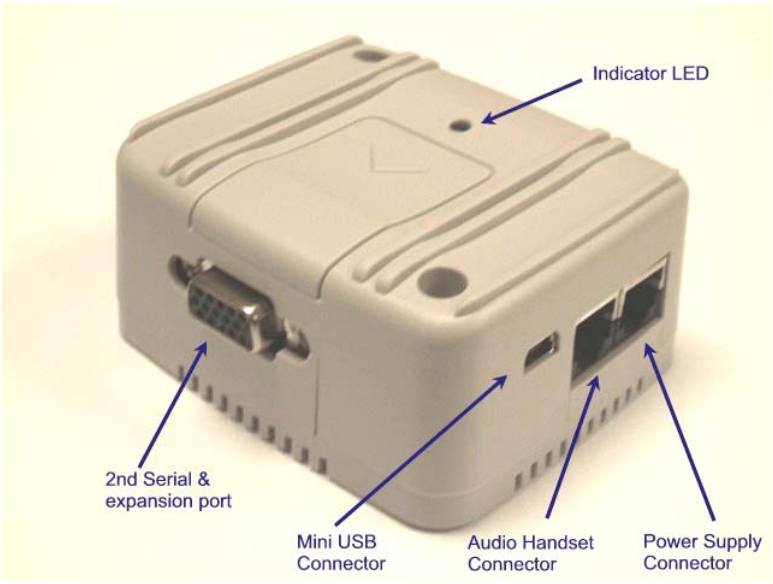


Figure 3. MTX-63/65 Module viewed from the right side

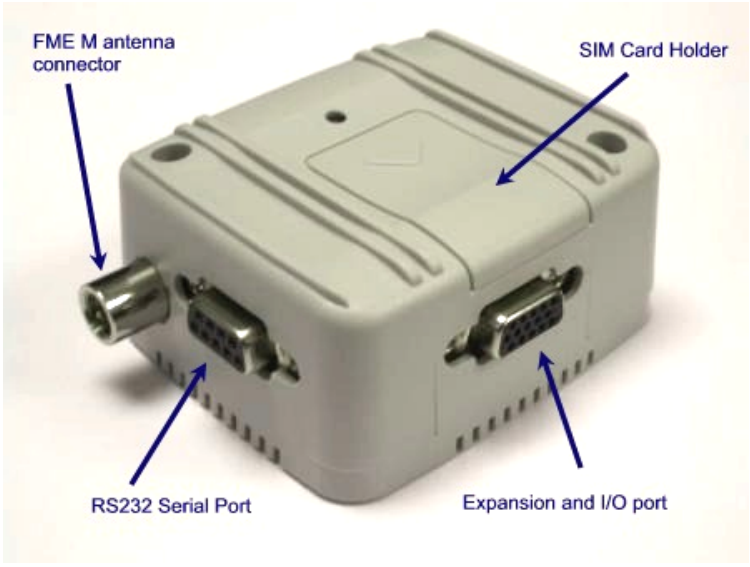


Figure 4. MTX-63/65 Module viewed from the left side

2.2. Dimensions

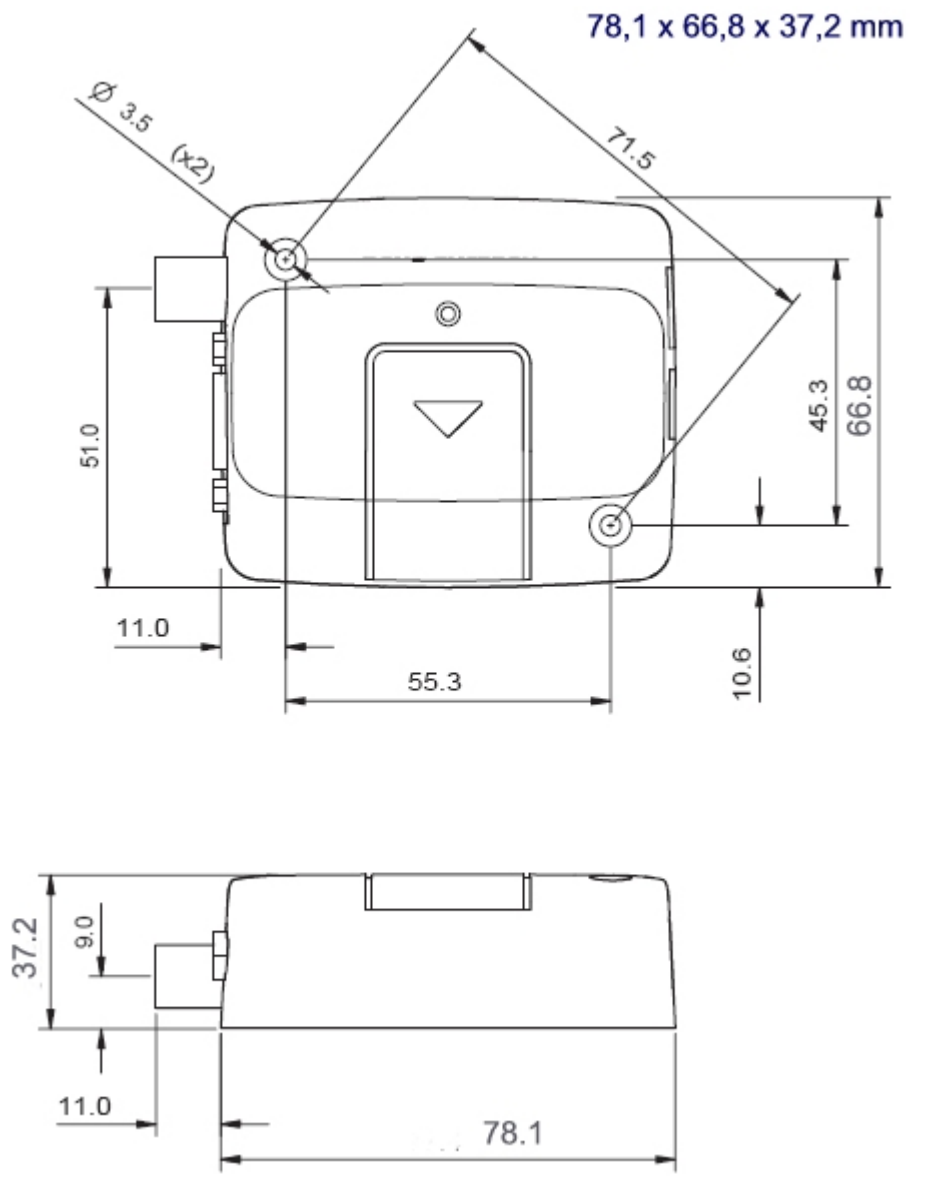


Figure 5. Dimensions of the MTX-63/65 terminal in mm

3. ELECTRICAL DESCRIPTION

All electrical connections to the module are protected in compliance with the standard air and contact Electrostatic Discharge (ESD).

The module uses the following industry standard connectors:

- D-Sub 9 pin female (Main RS232 serial port)
- High density 15 pin D-Sub(Secondary RS232 UART and extended I/O interface)
- RJ12 6-way (power supply connector)
- RJ12 4-way (handset connector)
- SIM card reader
- FME male coaxial jack (antenna connector)

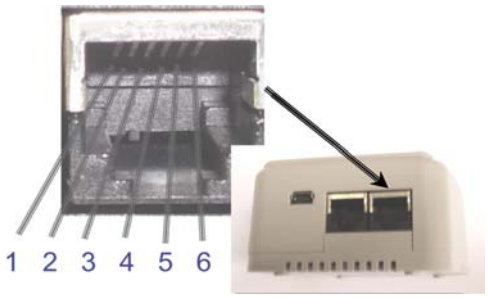
3.1 Power Connector

An RJ12 6-way connector, as shown and described below, serves means of supplying and controlling d.c. power to the modem.

The supply voltage, VCC, required by the modem is in the range 6-32V d.c. The power supply has to be a single voltage source capable of providing a peak during an active transmission. The uplink burst causes strong ripples (drop) on the power lines.

Application of the supply voltage does not switch the modem on. To do so an additional active-high control signal, TURN_ON, must applied for > 0.2s.

A second active-high control signal, TURN_OFF, can be used to switch modem off when applied for 1 - 2 seconds, or can be used to perform hardware reset when applied for > 3.5s.



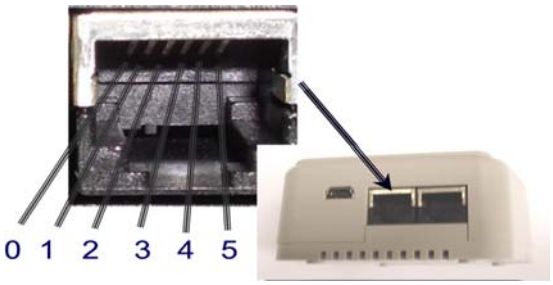
PIN:	*Signal*	*Dir*	*Limits*	*Description*
1	VCC	Input	6-32 V DC	Positive power input
2	Not connected	-		
3	TURN_OFF	Input	5 – VCC	Active high control line used to switch off or reset the modem VIH > 5V, VIL < 2V Power off: t >10ms
4	TURN_ON	Input	5 – VCC	Active high control line used to switch on the modem VIH > 5V, VIL < 2V Power on: t > 0.2s
5	VDDLP	I/O	Vmax 4,3 V	Backup the RTC from an external capacitor or a battery (rechargeable or non-chargeable).
6	GND	Input		Negative power (ground)

Note. VCC and GND are reverse polarity and overvoltage protected.

3.2 Audio Connector

A 6-way 4-poles RJ connector, as shown below, allows a telephone handset to be plugged into the modem, giving access to the microphone and earpiece signals. The connector may also be used to drive other analogue audio sub-systems or devices.

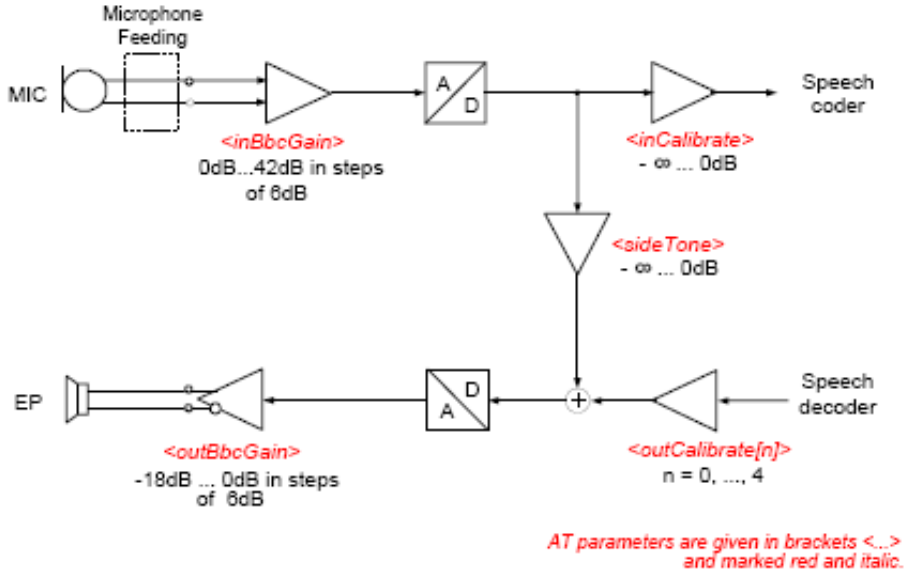
The audio interface provides one analog input for a microphone and one analog output for an earpiece.
• The microphone input and the earpiece output are balanced.
• For electret microphones a supply source is implemented.
• The MTX-63/65 is pre-configured to work with a range of handsets, the audio interface is flexible and its performance can be configured, using AT commands, to match a particular handset or audio subsystem.
• Earpiece outputs are short-circuit protected.



Audio handset connection.

Audio signal descriptions are listed below:

Pin	*Signal*	*Dir*	*Description*
0	Not connected		
1	MICN	I	Microphone negative input
2	EPN	O	Earpiece negative output
3	EPP	O	Earpiece positive output
4	MICP	I	Microphone positive input
5	Not connected		



The electrical characteristics of the voiceband part vary with the audio mode. Specifications are listed in following table. To suit several types of audio equipment, three audio modes given by default can be selected by the AT command AT^SNFS.
The audio mode 1 are optimized for the reference handset (type Votronic) connected to the MTX-63/65 Terminal, and to ensure that the reference parameters are always within the limits demanded by the standards they cannot be changed by AT command. Furthermore, the reference parameters are set as factory default.
In audio mode 4 and 5, the gain in the microphone, earpiece and the side tone path can be adjusted from the cellular device application by using further AT commands.
Please note that the 2nd audio interface of the TC63/655 module is not connected in the MTX-63/65 Terminal. Audio modes 2, 3 and 6 can be selected by setting AT^SAIC=2,1,1,

Mode No AT^SNFS=	***1 (Default settings, not adjustable)***	***4***	***5***
Name	Default Handset	User Handset	Plain Codec 1
Purpose	Recommended handset	User provided handset	Direct access to speech coder
Gains programmable via AT command	NO	YES	YES
Sidetone	YES	YES	YES
Volume control	NO	YES	YES
Echo control (send)	Cancellation and suppression	Cancellation and suppression	NO
Noise suppression	YES	YES	NO
MIC input signal for 0dBm0 @ 1024 Hz (at default gain settings)	12.5 mV	12.5 mV	400 mV
Earpiece output signal in mV eff. @ 0dBm0, 1024 Hz, no load (at default gain settings); @ 3.14 dBm0	475 mV	475 mV (default @ max volume)	1.5 V 6.0 Vpp
Sidetone gain (at default settings)	24.9 dB	24.9 dB	-∞ dB

The electrical characteristics are given in the table below.

Function	Signal name	IO	Parameter	Min.	Typ.	Max.	Unit
Microphone	MICP, MICN	I	DC (no load) at MICP	5.3	5.4	5.6	V
			DC at MICP in POWER DOWN		0V		V
			DC (no load) at MICN		0		V
			DC Resistance differential MICN, MICP (balanced)	4.6	4.7	4.8	kOhm
			Impedance Zi (balanced)	3.9	4.0	4.1	kOhm
			Input level Uimax			0.6	VPP
			Restricted Input level Uires 7			1.6	VPP
			Gain range 6 dB steps	0		42	dB
			Frequency Range	200		3900	Hz
			fine scaling by DSP (inCalibrate)	-∞		0	dB
Earpiece	EPP, EPN	O	Impedance (balanced)	8			Ohm
			AC output level UO Gain = 0dB @ 3.14 dBm0 no load		5.97		VPP
			Gain range	-18		0	dB
			Gain accuracy			0.8	dB
			Frequency area	200		3900	Hz
			DC Offset (balanced)			100	mV
			Attenuation distortion for 200...3900Hz			1	dB
			Out-of-band discrimination		70		dB
LEAudio			Length of Audio (Handset) cable			3	m

Unless otherwise stated, all specified values are valid for gain setting (gs) 0dB and 1kHz test signal.
gs = 0dB means audio mode = 5, inBbcGain= 0, inCalibrate = 32767, outBbcGain = 0, OutCalibrate = 16384, sideTone = 0.
The electrical characteristics of the voiceband part depend on the current audio mode selected by the AT command AT^SNFS. See Table 9: Audio modes.
The audio modes 4 and 5 can be adjusted by parameters. Each audio mode is assigned a separate parameter set.

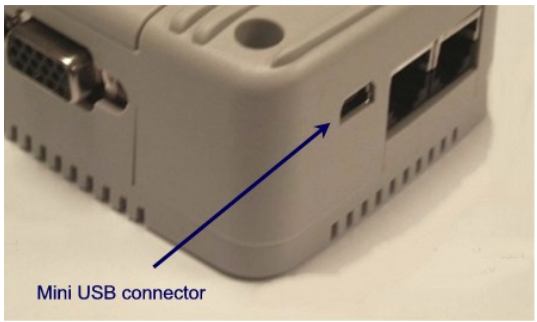
Audio Parameters Adjustable by AT Commands

Parameter	*Influence to*	*Range*	*Gain range*	*Calculation*
inBbcGain	MICP/MICN analog amplifier gain of baseband controller before ADC	0...7	0...42dB	6dB steps
inCalibrate	digital attenuation of input signal after ADC	0...32767	-∞...0dB	20 * log (inCalibrate/ 32768)
outBbcGain	EPP/EPN analog output gain of baseband controller after DAC	0...3	0...-18dB	6dB steps
outCalibrate[n] n = 0...4	Digital attenuation of output signal after speech decoder, before summation of sidetone and DAC present for each volume step[n]	0...32767	-∞...+6dB	20 * log (2 * outCalibrate[n]/ 32768)
sideTone	Digital attenuation of sidetone is corrected internally by outBbcGain to obtain a constant sidetone independently to output volume	0...32767	-∞...0dB	20 * log (sideTone/ 32768)

3.3 Mini USB Connector

The USB 2.0 interface allows the connectivity to all relevant PCs and control boards in office and industrial environments. The USB interface is a USB 2.0 full speed (12Mbit/s) interface for AT-C modem functionality between the MTX-63/65 Terminal and e.g. a PC.

It can be operated on a USB 2.0 Full Speed or High Speed root hub (a PC host), but not on a generic USB 2.0 High Speed hub which translates High Speed (480 Mbit/s/) to Full Speed (12 Mbit/s).



In MTX-65 terminal the USB port has different functions depending on whether or not Java is running. Under Java, the lines may be used for debugging purposes. If Java is not used, the USB interface is available as a command and data interface and for downloading firmware.

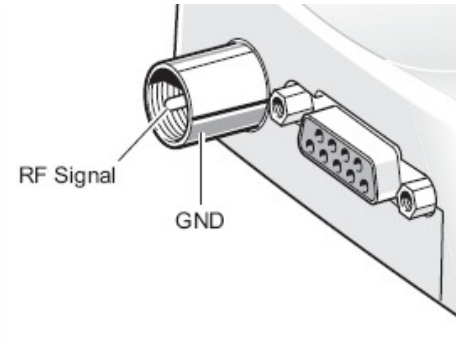
The USB I/O-pins are capable of driving the signal at min 3.0V. They are 5V I/O compliant. To properly connect the module's USB interface to the host a USB 2.0 compatible connector is required. Furthermore, the USB modem driver delivered with MTX65 must be installed as described below.

The USB host is responsible for supplying, across the VUSB_IN line, power to the module's USB interface, but not to other MTX65 interfaces. This is because MTX65 is designed as a self powered device compliant with the "Universal Serial Bus Specification Revision 2.0"

There are available drivers for Windows environment applications. Visit MTX-63/65 web page at: www.matrix.es/MTX-TERMINALS

3.4 Antenna Connector

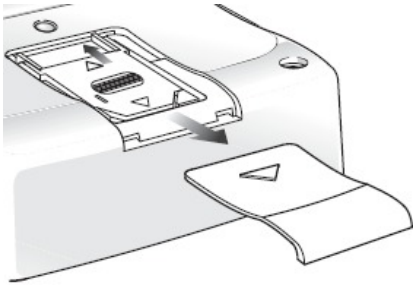
The antenna connector allows transmission of radio frequency (RF) signals between the modem and an external customer-supplied antenna. The modem is fitted with a 50Ω, FME male coaxial jack.

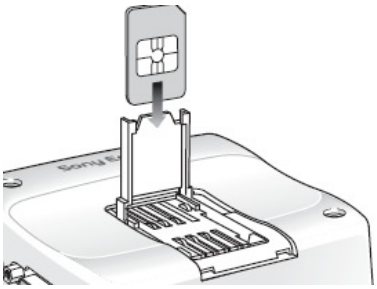


The external antenna must be matched properly to achieve best performance regarding radiated power, DC-power consumption, modulation accuracy and harmonic suppression.

3.5. SIM card reader

The MTX-63/65 Terminal is fitted with a SIM card reader designed for 1.8V and 3V SIM cards. It is the flip-up type which is lockable in the horizontal position and is accessed through a removable panel as shown below.





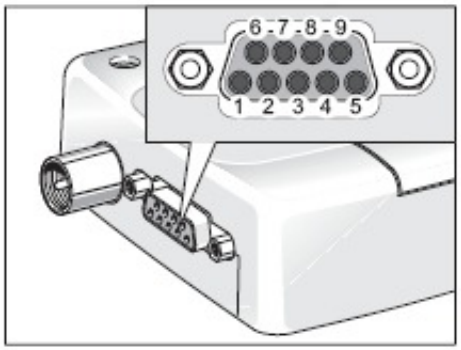
The card holder is a five wire interface according to GSM 11.11. A sixth pin has been added to detect whether or not the SIM card drawer is inserted.

Removing and inserting the SIM card during operation requires the software to be reinitialized. Therefore, alter reinserting the SIM card it is necessary to restart MTX65 Terminal.

The full operation of the MTX-63/65 relies on a SIM card being inserted. Some MTX-63/65 functionality may be lost if you try to operate the control terminal without a SIM card

3.6 MAIN Serial RS232 Interface Port ASC0

The modem supports a standard RS232 serial interface (EIA/TIA 574) via its 9 pin Sub-D connector, shown below.



1 DCD 4 DTR 7 RTS
2 RD 5 GND 8 CTS
3 TD 6 DSR 9 RI

MTX-63/65 Terminal is designed for use as a DCE. (data circuit-terminating equipment) based on the conventions for DCE-DTE connections it communicates with the customer application (DTE- data terminating equipment) using the following signals:

- Port TxD @ application sends data to TXD of MTX-63/65 Terminal
- Port RxD @ application receives data from RXD of MTX-63/65 Terminal

The RS-232 interface is implemented as a serial asynchronous transmitter and receiver conforming to ITU-T V.24 Interchange Circuits DCE. It is configured for 8 data bits, no parity and 1 stop bit and can be operated at fixed bit rates from 300bps to 460,800bps.

Autobauding supports bit rates from 1,2bps to 460,800bps. Hardware handshake using the /RTS and /CTS signals and XON/XOFF software flow control are supported.

In addition the modem control signals DTR, DSR, DCD and RING are available. The MODEM control signal RING (Ring Indication) can be used to indicate, to the cellular device application, that a call or Unsolicited Result Code (URC) is received.

The electrical characteristics of the serial port signals are shown below:
Note: Outputs at 3kOhm load

Pin	***Signal***	***Dir***	***Voltage levels***	***Description***
1	DCD	O	Min ±5V	Data carrier detect
2	RD 0	O	Min ±5V	Received data
3	TD 0	I	VILmax = 0.6V VIHmin = 2.4V VImax = ±25V	Transmitted data
4	DTR	I	VILmax = 0.6V VIHmin = 2.4V VImax = ±25V	Data terminal ready
5	GND	-	0V	Ground connection
6	DSR	O	Min ±5V	Data set ready
7	RTS	I	VILmax = 0.6V VIHmin = 2.4V VImax = ±25V	Request to send
8	CTS	O	Min ±5V	Clear to send
9	RI	O	Min ±5V	Ring indicator

Features

• Includes the data lines TXD0 and RXD0, the status lines RTS0 and CTS0 and, in addition, the modem control lines DTR0, DSR0, DCD0 and RING0.

• ASC0 is primarily designed for controlling voice calls, transferring CSD, fax and GPRS data and for controlling the GSM engine with AT commands.

• Full Multiplex capability allows the interface to be partitioned into three virtual channels, yet with CSD and fax services only available on the first logical channel. Please note that when the ASC0 interface runs in Multiplex mode, ASC1 cannot be used.

• The DTR0 signal will only be polled once per second from the internal firmware of MTX-63/65.

• The RING0 signal serves to indicate incoming calls and other types of URCs (Unsolicited Result Code). It can also be used to send pulses to the host application, for example to wake up the application from power saving state. To configure the RING0 line use following AT Command: AT^SCFG.

• By default, configured for 8 data bits, no parity and 1 stop bit. The setting can be changed using the AT command AT+ICF and, if required, AT^STPB. .

• ASC0 can be operated at fixed bit rates from 300 bps to 460800 bps.

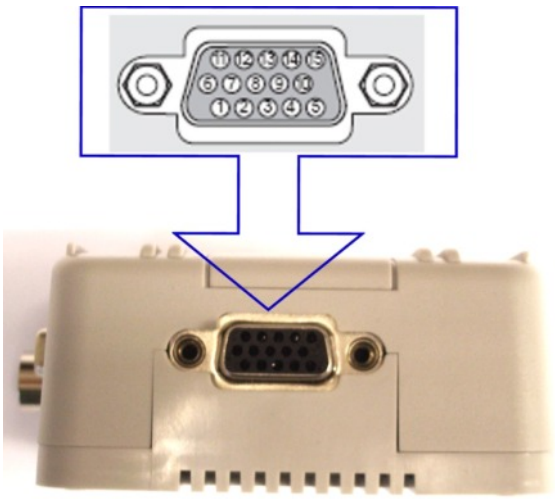
• By default, serial speed is autobauding: supports bit rates from 1200 to 460800 bps.

• Autobauding is not compatible with multiplex mode.

• Supports RTS0/CTS0 hardware flow control and XON/XOFF software flow control.

3.7 Expansion I/O port

The MTX-63/65 supports a range of configurable I/Os including a second 2-wire RS232 interface. on the 15 pin high density connector together with I2C bus and VTRC



1. I2CCLK SPICLK K	6. I2CDAT-SPIDO	11. IO 2
2. RD1	7. SPIDI	12. IO 4
3. TD1	8. SPICS	13. ADC2
4. IO 1	9. VEXT	14. GND
5. IO 3	10. DAC_OUT	15. ADC 1

Pin	MTX-63/65 Signal	Dir	Max. Voltage limits	Description
1	I2CCLK SPICLK	O	0.2 - 3.05 V	I2C or SPI bus clock signal
2	RD1	O	Min ±5V	Secondary RS232 ASC1 UART signal: Received data
3	TD1	I	VILmax = 0.6V VIHmin = 2.4V VImax = ±25	Secondary RS232 ASC1 UART signal Transmitted data. V IL < 0.6V, V IH > 2.4V
4	GPIO 1	I/O	Input: 0.8 - 3.05 Output: 0.2 - 3.05	Digital input/output I/O 1
5	GPIO 3	I/O	Input: 0.8 - 3.05 Output: 0.2 - 3.05	Digital input/output I/O 3
6	I2CDAT-SPIDO	I/O	Input: 0.8 - 3.05V Output: 0.2 - 3.05V	I2C data or SPI bus Data Output
7	SPIDI	I	0.8 - 3.05V	SPI bus Data Input
8	SPICS	O	0.3 – 3.05V	SPI bus Chip Select (master)
9	VEXT	O	2.75 – 3.05V Io max: -50mA	Output Voltage reference
10	DAC_OUT	O	0.2 – 3.05V	Digital Analog Converter / PWM signal output
11	GPIO 2	I/O	Input: 0.8 - 3.05 Output: 0.2 - 3.05	Digital input/output I/O 2
12	GPIO 4	I/O	Input: 0.8 - 3.05 Output: 0.2 - 3.05	Digital input/output I/O 4
13	ADC2	I	Vimin = 0V, VImax = 2.4V Ri ≈ 750kOhms6 Measurement interval: 100ms – 30s Sensitivity, accuracy: 2400 steps (1step = 1mv) Accuracy: ± 0.5mV	Analog-Digital converter Input 2
14	GND		0V	Ground connection
15	ADC 1	I	Vimin = 0V, VImax = 2.4V Ri ≈ 750kOhms6 Measurement interval: 100ms – 30s Sensitivity, accuracy: 2400 steps (1step = 1mv) Accuracy: ± 0.5mV	Analog-Digital converter Input 2

3.7.1. SECONDARY SERIAL RS232 INTERFACE ASC1

The ASC1 interface is available as a 2-wire unbalanced, asynchronous modem interface ASC1 conforming to ITU-T V.24 protocol DCE signalling.

Pin	*Name*	*Direction*		*Function*
2	RD1	I	±5 v	Secondary RS232 UART signal: Received data
3	TD1	o	± 25V	Secondary RS232 UART signal Transmitted data. V IL < 0.6V, V IH > 2.4V

Features
• Includes only the data lines TD1 and RD1 Supports only XON/XOFF software flow control.
• On ASC1 no RING line is available. The indication of URCs on the second interface depends on the settings made with the AT^SCFG command.
• Configured for 8 data bits, no parity and 1 or 2 stop bits.
• ASC1 can be operated at fixed bit rates from 300 bps to 460800 bps. Autobauding is not supported on ASC1.

3.7.2. I2C Serial Control Bus

I2C is a serial, 8-bit oriented data transfer bus for bit rates up to 400kbps in Fast mode. It consists of two lines, the serial data line I2CDAT and the serial clock line I2CCLK.
The MTX-63/65 module acts as a single master device, e.g. the clock I2CCLK is driven by module. I2CDAT is a bi-directional line.

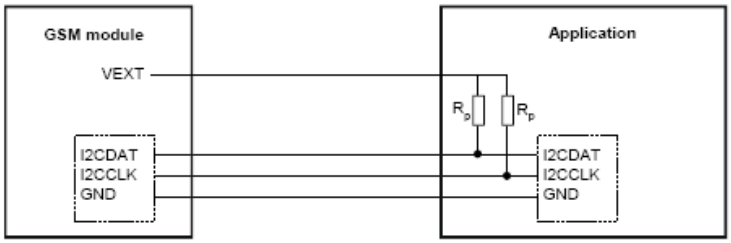
Each device connected to the bus is software addressable by a unique 7-bit address, and simple master/slave relationships exist at all times. The module operates as master-transmitter or as master-receiver. The customer application transmits or receives data only on request of the module.

Pin	*MTX-63/65 Signal*	*Dir*	*Max. Voltage limits*	*Description*
1	I2CCLK	O	0.2 - 3.05 V	I2C bus clock signal
6	I2CDAT	I/O	Input: 0.8 - 3.05V Output: 0.2 - 3.05V	I2C data bus
14	GND		0V	Ground connection

To configure and activate the I2C bus use the AT^SSPI command. If the I2C bus is active the two lines I2CCLK and I2DAT are locked for use as SPI lines. Vice versa, the activation of the SPI locks both lines for I2C.

The I2C interface is powered from an internal VEXT supply line so the I2C interface will be properly shut down when the module enters the Power-down mode.

Function	Signal name	IO	Signal form and level	Comment
I2C interface	I2CCLK	O	RO ≈ 33Ω VOLmax = 0.25V at I = 2mA VOHmin = 2.50V at I = -0.5mA VOHmax = 3.05V	I2CDAT is configured as pen Drain and needs a pull-up resistor in the host application. According to the I2C Bus Specification Version 2.1 for the fast mode a rise time of max. 300ns is permitted. There is also a maximum VOL=0.4V at 3mA specified. The value of the pull-up depends on the capacitive load of the whole system (I2C Slave + lines). The maximum sink current of I2CDAT and I2CCLK is 4mA. If lines are unused keep pins open.
	I2CDAT	I/O	RO ≈ 33Ω VOLmax = 0.25V at I = 2mA VILmax = 0.8V VIHmin = 2.0V VIHmax = 3.05V	

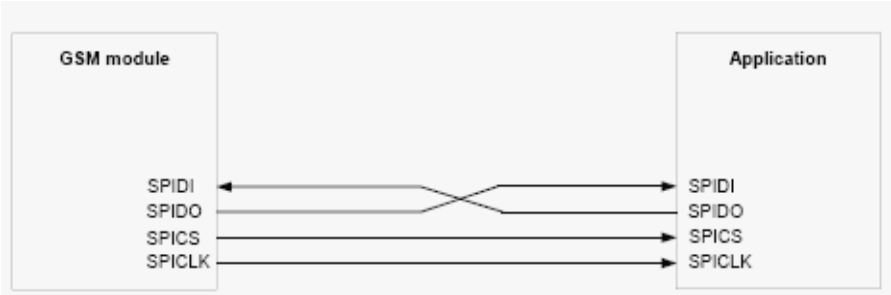


3.7.3. SPI Bus

The SPI (serial peripheral interface) is a synchronous serial interface for control and data transfer between the MTX-63/65 Terminal and the connected application. Only one application can be connected to the module's SPI. The interface supports transmission rates up to 6.5Mbit/s.

It consists of four lines, the two data lines SPIDI/SPIDO, the clock line SPICLK and the chip select line SPICS.

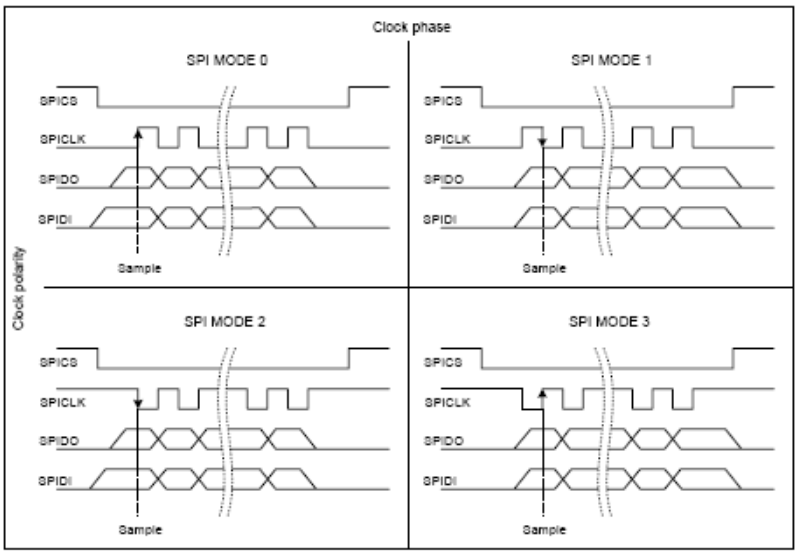
The MTX-63/65 Terminal acts as a single master device, e.g. the clock SPICLK is driven by module. Whenever the SPICS pin is in a low state, the SPI bus is activated and data can be transferred from the module and vice versa. The SPI interface uses two independent lines for data input (SPIDI) and data output (SPIDO).



To configure and activate the SPI bus use the AT^SSPI command. If the SPI bus is active the two lines I2CCLK and I2DAT are locked for use as I2C lines.

In general, SPI supports four operation modes. The modes are different in clock phase and clock polarity. The module's SPI mode can be configured by using the AT command AT^SSPI. Make sure the module and the connected slave device works with the same SPI mode.

Following picture shows the characteristics of the four SPI modes. The SPI modes 0 and 3 are the most common used modes.



<

The SPI interface is only available if the pins 7 and 8 of the IO interface connector are not used as I2C interface.

Signal name	*Pin*	*Description*
SPICS	8	Chip select – selects and activates the external device via a low signal.
SPIDI	7	Data in – serial data input line (from the external device to the MTX65 Terminal)
I2CDAT_SPIDO	6	Data out – serial data output line (from the MTX65 Terminal to the external device)
I2CCLK_SPICLK	1	Serial clock line

3.7.4. General Purpose IO

Pin	*MTX65 Signal*	*Dir*	*Max. Voltage limits*	*Description*
4	IO 1	I/O	-0.5 - VREF	Digital Input/Output I/O 1 Digital VREF
11	IO 2	I/O	-0.5 - VREF	Digital Input/Output I/O 2 Digital VREF
5	IO 3	I/O	-0.5 - VREF	Digital Input/Output I/O 3 Digital VREF
12	IO 4	I/O	-0.5 - VREF	Digital Input/Output I/O 4 Digital VREF
10	DAC OUT	O		Digital to Analog Output Converter

The MTX-65 Terminal provides 4 GPIO pins at the IO interface connector. Each GPIO line is ESD protected and a serial resistor of 100 Ohm is added. This avoids short circuits and is especially important in the first stages of development where the Java application is not yet fully implemented. The signal direction (input/output) of the GPIO lines is selectable with AT commands

The GIPO related AT commands are the following: AT^SPIO, AT^SCPIN, AT^SCPOL, AT^SCPORT, AT^SDPORT, AT^SGIO, AT^SSIO.

When the MTX-65 starts up, all GPIO pins are set to high-impedance state after initializing, so, they're connected internally with a pull-down resistor. This is necessary to keep these pins from floating or driving any external devices before all settings are done by AT command (at least AT^SPIO, AT^SCPIN), and after closing the GPIOs again.

All general purpose IO (GPIO) is programmable by the user.

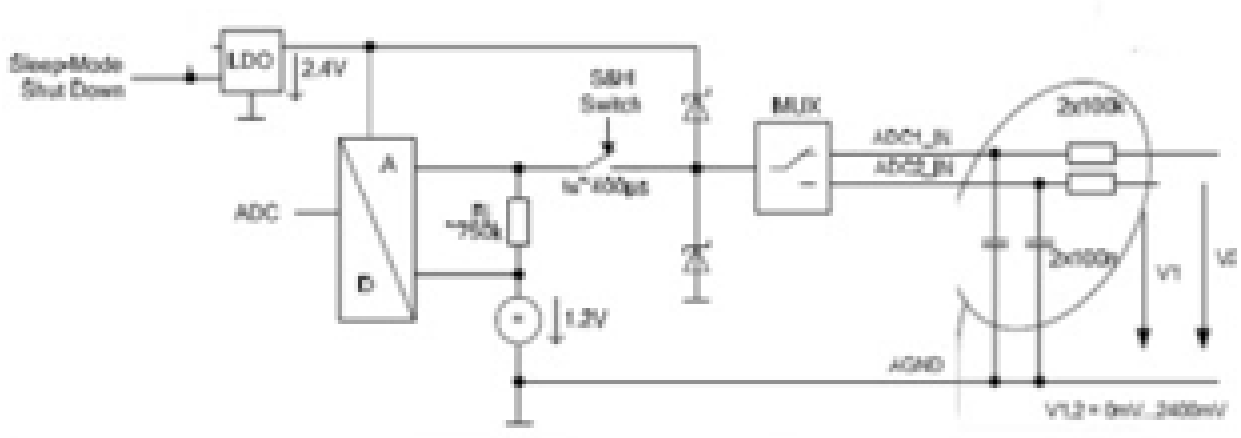
GPIO is programmable for the following features:
• An input or output
• Level-sensitive or transition-sensitive
• Open drain or direct drive
• Polarity (inversion)
• Internal pull-up resistors

3.7.5. Analog-to-Digital Converter (ADC)

The ADC of the MTX65 consists of 2 independent, unbalanced, multiplexed analog inputs that can be used for measuring external DC voltages in the range of 0mV…+2400mV. The ADC has a resolution of 12 bits.

Use the command AT^SRADC described in [1] to select the analog inputs ADC1_IN or ADC2_IN, to set the measurement mode and read out the measurement results. The measured values are indicated in mV.

There is no out of range detection. Voltages beyond these limits cannot be measured:
• Underflow: Values ≤ -25mV
• Overflow: Values > 2425mV
The sample period is adjustable from 30s up to 100ms by AT^SRADC Only during sample time (ts~400µs) the S&H Switch is closed.



3.7.6 Real Time Clock

The MTX-63/65 contains a real time clock (RTC) to maintain accurate timekeeping and to enable "time stamping" of messages.

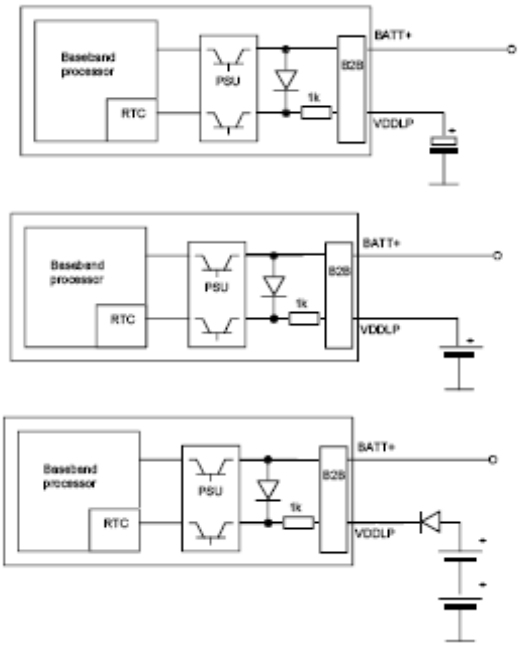
The RTC is powered with the signal VRTC present in pin 5 of the POWER CONNECTOR.
The user must connect this pin to an external energy device like a battery or super-capacitor to provide back-up power to maintain the RTC. Example: If using a 300mF supercap the RTC can be maintain for at least 12 hours.

The internal Real Time Clock of MTX-63/65 is supplied from a separate voltage regulator in the analog controller which is also active when MTX-63/65 is in POWER DOWN status. An alarm function is provided that allows to wake up MTX-63/65 to Airplane mode without logging on to the GSM network.

In addition, you can use the VDDLP pin on the Power Connector to backup the RTC from an external capacitor or a battery (rechargeable or non-chargeable). The capacitor is charged by the BATT+ line of TC63/65. If the voltage supply at BATT+ is disconnected the RTC can be powered by the capacitor.

The size of the capacitor determines the duration of buffering when no voltage is applied to MTX-63/65, i.e. the larger the capacitor the longer MTX-63/65 will save the date and time.
A serial 1kΩ resistor placed on the board next to VDDLP limits the charge current of an empty capacitor or battery.

The following figures show various sample configurations.



The MTX-63/65 can accommodate this battery or super-cap inside, and the MTX-63/65 can be ordered with this special option by request. Please contact your sales nearest distributor.

3.8. Software Updates

It is possible and sometimes necessary to update the MTX-63/65 software.
Updates must be carried out by an approved technician.
Please contact your supplier for details Service/Programming

4. OPERATION

4.1 Switching On the Modem

There are two ways to switch on the modem, once power is applied.
• either assert TURN_ON high for > 0.4s;
• or activate the RS232 control line DTR, high for > 0.4s.
The modem is fully operational after 4 seconds. Logging onto a network may take longer than this and is outside the control of the modem.

The modem can be configured to start up at the time power is applied by permanently tying power connector signals TURN_ON (pin 4) and VCC (pin 1) together. In this case DTR must be used to switch the modem on again after it has been switched off or reset, while power is still applied.

4.2 Switching Off the Modem

There are 2 ways to switch off (power down) the modem as described below:

• Either use the AT^SMSO command; RECOMMENDED.
The AT^SMSO command lets the MTX-63/65 Terminal log off from the network and allows the software to enter into a secure state and safe data before disconnecting the power supply. The mode is referred to Power-down mode. In this mode only the RTC stays active.

• Or assert TURN_OFF, pin 3 of power supply connector, high for >1 seconds. A delay of up to 10s is experienced as the modem logs off the network

Note! The DTR line must be deactivated prior to switching off the modem to ensure the unit switches off correctly.

Before disconnecting the power supply from the POWER pin makes sure the MTX63-65 Terminal is in a safe condition. A save condition is waiting 1s after the "^SHUTDOWN" result code has been indicated.

4.3 Operating States/LED

The modem has a green LED, which displays the operating status of the Terminal.
The LED can be operated in two different display modes: AT^SSYNC=1 or AT^SSYNC=2 (factory default).

mode	LED Status
AT^SSYNC=0	SYNC mode: Enables the SYNC pin to indicate growing power consumption during a transmit burst. You can make use of the signal generated by the SYNC pin, if power consumption is your concern. To do so, ensure that your application is capable of processing the signal. Your platform design must be such that the incoming signal causes other components to draw less current. In short, this allows your application to accommodate current drain and thus, supply sufficient current to the GSM engine if required. Note: <mode>=0 is the factory default of the TC65 module.
AT^SSYNC=1	LED mode: Enables the SYNC pin to drive a status LED installed in your application according to the specifications provided in [2]. The coding of the LED is described in Section 19.6.1, ME status indicated by status LED patterns.
AT^SSYNC=2	LED mode: Like <mode>=1, but, additionally, enables different LED signalization in SLEEP mode depending on the status of PIN authentication and network registration. Please see AT+CFUN for details on SLEEP mode. Note: <mode>=2 is the factory default of the MTX65 Terminal.

In following table is showed the different operating status and changing this mode

LED behavior	ME operating status if AT^SSYNC=1	ME operating status if AT^SSYNC=2
Permanently off	ME is in one of the following modes: -POWER DOWN mode AIRPLANE mode CHARGE ONLY mode NON-CYCLIC SLEEP mode CYCLIC SLEEP mode with no temporary wake-up event in progress *(1)*	ME is in one of the following modes: -POWER DOWN mode AIRPLANE mode CHARGE ONLY mode
600 ms on / 600ms off	Limited Network Service: No SIM card inserted or no PIN entered, or network search in progress, or ongoing user authentication, or network login in progress	Same as for AT^SSYNC=1
75 ms on / 3 s off	IDLE mode: The mobile is registered to the GSM network (monitoring control channels and user interactions). No call is in progress.	Same as for AT^SSYNC=1
75 ms on / 75 ms off / 75 ms on / 3 s off	One or more GPRS PDP contexts activated.	Same as for AT^SSYNC=1
500 ms on / 50 ms off	Packet switched data transfer is in progress	Same as for AT^SSYNC=1
Permanently on	Depending on type of call: Voice call: Connected to remote party. Data call: Connected to remote party or exchange of parameters while setting up or disconnecting a call.	Same as for AT^SSYNC=1
<n> ms on / <n> ms off *(2)*	Not possible: With AT^SSYNC=1, LED signalization is disabled in SLEEP mode.	SLEEP mode is activated (AT+CFUN parameter <fun>≠ 1), but the ME is not registered to the GSM network (e.g. SIM not inserted or PIN not entered, and therefore, either no network service or only Limited Network Service is avail-able.

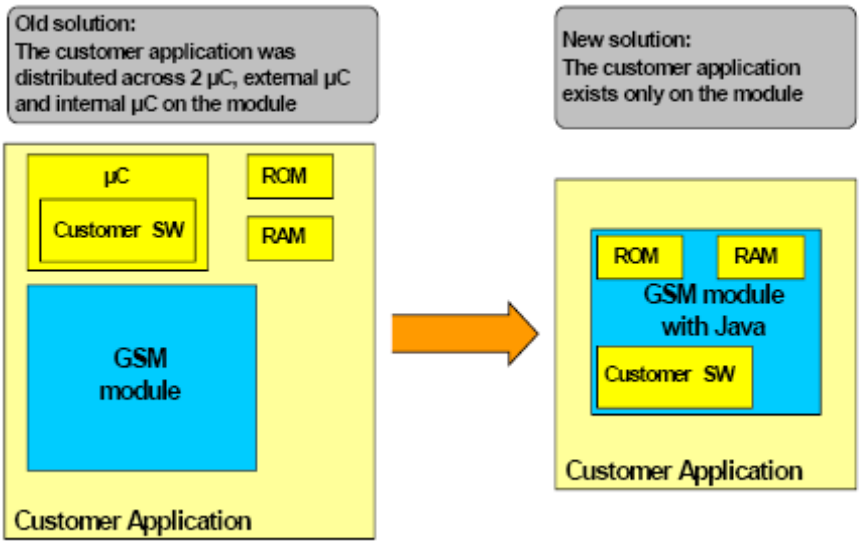
1) When a temporary wake-up event (for example a call, a URC, a packet switched transfer) occurs in CYCLIC SLEEP mode the LED flashes according to the patterns listed above. See Section 2.9.1, Wake up the ME from SLEEP mode for details on the various SLEEP modes and wake-up events.
2) The duration of <n> and <m> depends on the network: In SLEEP mode, the module can only change its LED status during intermittent wake-up periods when listening to paging information from the base station. Therefore the values of <n> and <m> vary as follows:
<n> = value from 471 ms to 2118 ms
<m> = 3000 ms

5. EMBEDDED APPLICATIONS. ONLY MTX-65

The MTX-65 can embed an internal application written in popular JAVA language. Java technology and several peripheral interfaces on the module allow you to easily integrate your application.

This way, the customer application can be reduced because all the resources: Microcontroller, Flash & RAM memory and all kind of I/O and bus peripheral is allowed to use by the customer.

This solution saves the external intelligence with all the associate costs and also saving space and power consumption.



Open application resources

- ARM© Core, Blackfin© DSP
- Memory: 400 KB (RAM) and1.7 MB (Flash)
- Improved power-saving modes

Java™ features:

- CLDC 1.1 HI
- J2ME™ profile IMP-NG
- Secure data transmission with HTTPS, SSL and PKI

Over-the-air update

1. Application SW: OTAP
2. Firmware: FOTA (OMA compliant)

6 SAFETY AND PRODUCT CARE

Please read the information in this section and the information in "Installation of the Modem", before starting your integration work!

6.1. Safety instructions

PLEASE READ THESE SAFETY INSTRUCTIONS AND KEEP A COPY OF THEM.

• Always ensure that use of the modem is permitted. The modem may present a hazard if used in proximity to personal medical electronic devices. As a rule, the modem must not be used in hospitals, airports or planes.

• Never use the modem at a gas station, refueling point, blasting area or in any other environment where explosives may be present.

• Operating the modem close to other electronic devices, such as antennas, television sets, and radios may cause electromagnetic interference.

• This product is intended to be used with the antenna or other radiating element at least 20cm away from any part of the human body. In applications where this rule cannot be applied, the application designer is responsible for providing the SAR measurement test report and declaration.

• You are responsible for observing your country's safety standards, and where applicable, the relevant wiring rules.

6.2. General precautions

The MTX-63/65 Terminal as a stand alone item is designed for indoor use only. To use outside it must be integrated into a weatherproof enclosure. Do not exceed the environmental and electrical limits as specified in "Technical Data".

• Avoid exposing the modem to lighted cigarettes, naked flames or to extreme hot or cold temperature.

• Never try to dismantle the modem yourself. There are no components inside the modem that can be serviced by the user. If you attempt to dismantle the modem, you may invalidate the warranty.

• The MTX-63/65 Terminal must not be installed or located where the surface temperature of the plastic case may exceed 85°C.

• All cables connected to the MTX-63/65 Terminal must be secured or clamped, immediately adjacent to the modem's connectors, to provide strain relief and to avoid transmitting excessive vibration to the modem in the installation
• Ensure the d.c. cable, supplying power to the MTX-63/65 Terminal, does not exceed 3 meters.

• To protect power supply cables and meet the fire safety requirements when the unit is powered from a battery or a high current supply, connect a fast 1.25A fuse in line with the positive supply.

• Do not connect any incompatible component or product to the MTX-63/65 Terminal.

Note! MTX-63/65 distributors and sales offices may refuse warranty claims where evidence of product misuse is found.

6.3. SIM card precautions

Before handling the SIM card in your application, ensure that you are not charged with static electricity. Use proper precautions to avoid electrostatic discharges.

• When the SIM card hatch is opened, the SIM card connectors lie exposed under the SIM card holder.

Caution! Do not touch these connectors! If you do, you may release an electrical discharge that could damage the modem or the SIM card.

• When designing your application, the SIM card's accessibility should be taken into account. We always recommend that you have the SIM card protected by a PIN code.
This will ensure that the SIM card cannot be used by an unauthorized person.

6.4. Antenna precautions

If the antenna is to be mounted outside, consider the risk of lightning. Follow the instructions provided by the antenna manufacturer.

• Never connect more than one modem to a single antenna. The modem can be damaged by radio frequency energy from the transmitter of another modem.

• Like any mobile station, the antenna of the modem emits radio frequency energy. To avoid EMI (electromagnetic interference), you must determine whether the application itself, or equipment in the application's proximity, needs further protection against radio emission and the disturbances it might cause. Protection is secured either by shielding the surrounding electronics or by moving the antenna away from the electronics and the external signals cable.

• The modem and antenna may be damaged if either come into contact with ground potentials other than the one in your application. Beware, ground potential are not always what they appear to be.

6.5. Radio Frequency (RF) exposure and SAR

Your wireless modem device is a low-power radio transmitter and receiver (transceiver). When it is turned on, it emits low levels of radio frequency energy (also known as radio waves or radio frequency fields).

Governments around the world have adopted comprehensive international safety guidelines, developed by scientific organizations, e.g. ICNIRP (International Commission on Non-Ionizing Radiation Protection) and IEEE (The Institute of Electrical and Electronics Engineers Inc.), through periodic and thorough evaluation of scientific studies. These guidelines establish permitted levels of radio wave exposure for the general population. The levels include a safety margin designed to assure the safety of all persons, regardless of age and health, and to account for any variations in measurements.

Specific Absorption Rate (SAR) is the unit of measurement for the amount of radio frequency energy absorbed by the body when using a transceiver. The SAR value is determined at the highest certified power level in laboratory conditions, but the actual SAR level of the transceiver while operating can be well below this value. This is because the transceiver is designed to use the minimum power required to reach the network.

The MTX-63/65 wireless modem device has been approved for applications where the antenna is located >20cm from the body. In all other configurations the integrator is responsible for meeting the local SAR regulations.

Integrators of the MTX-63/65 wireless modem device are responsible for ensuring that they meet the SAR regulatory requirements of the countries in which they intend to operate the device, and that their documentation contains the relevant SAR declaration, certification information, and user guidance as appropriate.

6.6. Personal Medical Devices

Wireless modem devices may affect the operation of cardiac pacemakers, hearing aids and certain other implanted equipment. If a minimum distance of 15 cm (6 inches) is maintained between the MTX-63/65 terminal radiating antenna and a pacemaker, the risk of interference is limited. If the integrator's application is likely to be situated in the vicinity of personnel, a suitable warning should be contained in the equipment manual to this effect.

7. INSTALLATION OF THE MODEM

This chapter gives you advice and helpful hints on how to integrate the MTX-63/65 Terminal into your application from a hardware perspective.

7.1 Where to install the modem

There are several conditions which need to be taken into consideration when designing your application as they might affect the modem and its function. They are:

7.1.1 Environmental conditions

The modem must be installed so that the environmental conditions stated in the Technical Data chapter, such as temperature, humidity and vibration are satisfied.
Additionally, the electrical specifications in the Technical Data section must not be exceeded.

7.1.2 Signal strength

The modem has to be placed in a way that ensures sufficient signal strength. To improve signal strength, the antenna can be moved to another position. Signal strength may depend on how close the modem is to a radio base station. You must ensure that the location at which you intend to use the modem, is within the network coverage area. Degradation in signal strength can be the result of a disturbance from another source, for example an electronic device in the immediate vicinity. More information about possible communication disturbances can be found in section 7.3.5.

When an application is completed, you can verify signal strength by issuing the AT command AT+CSQ. See "AT+CSQ Signal Strength".

Tip! Before installing the modem, use an ordinary mobile telephone to check a possible location for it. In determining the location for the modem and antenna, you should consider signal strength as well as cable length.

7.1.3 Connections of components to MTX-63/65 Terminal

The integrator is responsible for the final integrated system. Incorrectly designed or installed, external components may cause radiation limits to be exceeded. For instance, improperly made connections or improperly installed antennas can disturb the network and lead to malfunctions in the modem or equipment.

7.1.4 Network and Subscription

Before your application is used, you must ensure that your chosen network provides the necessary telecommunication services. Contact your service provider to obtain the necessary information.
• If you intend to use SMS in the application, ensure this is included in your (voice) subscription.• Consider the choice of the supplementary services

7.2 How to install the modem

7.2.1 Power supply

• Use a high-quality power supply cable with low resistance. This ensures that the voltages at the connector pins are within the allowed range, even during the maximum peak current.
• When the unit is powered from a battery or a high current supply, connect a fast 1.25A fuse in line with the positive supply. This protects the power cabling and modem.

7.2.2 Securing the modem

Before securing the modem take into account the amount of additional space required for the mating connectors and cables that will be used in the application.
• Where access is restricted, it may be easier to connect all the cables to the modem prior to securing it in the application.
• Securely attach the MTX-63/65 Terminal modem to the host application using two 3mm diameter pan-head screws

7.3 Antenna

7.3.1 General

The antenna is the component in your system that maintains the radio link between the network and the modem. Since the antenna transmits and receives electromagnetic energy, its efficient function will depend on:
• the type of antenna (for example, circular or directional);
• the placement of the antenna;
• communication disturbances in the vicinity in which the antenna operates.
In the sections below, issues concerning antenna type, antenna placement, antenna cable, and possible communication disturbances are addressed. In any event, you should contact your local antenna manufacturer for additional information concerning antenna type, cables, connectors, antenna placement, and the surrounding area.

You should also determine whether the antenna needs to be grounded or not. Your local antenna manufacturer might be able to design a special antenna suitable for your application.

7.3.2 Antenna type

Make sure that you choose the right type of antenna for the modem. Consider the following requirements:
• the antenna must be designed for the one of the frequency bands in use; please ask your network provider for more information:
- GSM 850/900 MHz
- GSM 1800/1900 MHz;

• the impedance of the antenna and antenna cable must be 50Ω;
• the antenna output-power handling must be a minimum of 2W;
• the VSWR value should be less than 3:1 to avoid damage to the modem.

7.3.3 Antenna placement

The antenna should be placed away from electronic devices or other antennas. The recommended minimum distance between adjacent antennas, operating in a similar radio frequency band, is at least 50cm. If signal strength is weak, it is useful to face a directional antenna at the closest radio base station. This can increase the strength of the signal received by the modem. The modem's peak output power can reach 2W.

RF field strength varies with antenna type and distance. At 10cm from the antenna the field strength may be up to 70V/m and at 1m it will have reduced to 7V/m. In general, CE-marked products for residential and commercial areas, and light industry can withstand a minimum of 3V/m.

7.3.4 The antenna cable

Use 50Ω impedance low-loss cable and high-quality 50Ω impedance connectors (frequency range up to 2GHz) to avoid RF losses. Ensure that the antenna cable is as short as possible. The Voltage Standing-Wave Ratio (VSWR) may depend on the effectiveness of the antenna, cable and connectors. In addition, if you use an adapter between the antenna cable and the antenna connector, it is crucial that the antenna cable is a high-quality, low-loss cable. Minimize the use of extension cables, connectors and adapters. Each additional cable, connector or adapter causes a loss of signal power.

7.3.5 Possible communications disturbances

Possible communication disturbances include the following:
• **Noise** can be caused by electronic devices and radio transmitters.
• **Path-loss** occurs as the strength of the received signal steadily decreases in proportion to the distance from the transmitter.
• **Shadowing** is a form of environmental attenuation of radio signals caused by hills, buildings, trees or even vehicles. This can be a particular problem inside buildings, especially if the walls are thick and reinforced.
• **Multi-path fading** is a sudden decrease or increase in the signal strength. This is the result of interference caused when direct and reflected signals reach the antenna simultaneously. Surfaces such as buildings, streets, vehicles, etc., can reflect signals.
• **Hand-over** occurs as you move from one cell to another in the GSM network. Your mobile application call is transferred from one cell to the next. Hand-over can briefly interfere with communication and may cause a delay, or at worst, a disruption.

8. ACCESSORIES

The MTX-63/65 has been type approved together with a range of accessories including:
Power supply, all type of antennas (indoor, outdoor, high gain, etc…), cables and DIN adapter

Following is an example of this, please visit www.matrix.es/MTX-Terminals to see the full-range of accessories

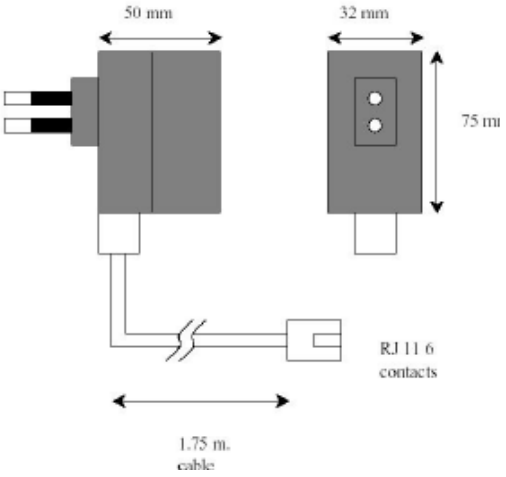
1. POWER SUPPLY

1.1 AC Power Adaptor

OPANIEL TECHNOLOGIES http://www.opaniel.com/
Model S1512-1212

Input: 240VAC, 0.1A power adaptor, 50-60Hz mains lead Euro plug option.
Output: 12V DC, 1.2A.
2m cable with RJ12 plug connector see below.
RJ12 plug proprietary pinout:

- Pin 1 = Positive
- Pin 2 = Not connected
- Pin 3 = Not connected
- Pin 4 = Positive
- Pin 5 = Not connected
- Pin 6 = Negative

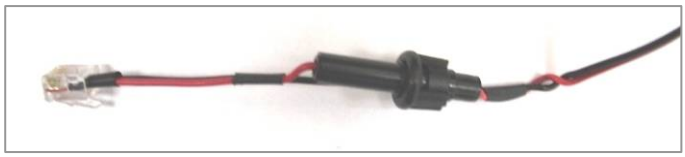


CE approved

ORDERING CODE: 901.004.167

1.2 DC cable

2,5m Fused DC Power Cable for GSM terminals
Fuse: Fast acting fuse ≥0.4A



ORDERING CODE: 118.003.330

2. ANTENNAS

2.1 Magnetic Dual Band Antenna (900/1800MHz)

OPANIEL TECHNOLOGIES http://www.opaniel.com
Model: MTX-FME F (whips 6 & 22 cm)

Magnetic-mount antenna, 3m RG174 cable with FME female connector
0dB radiator for whip 6 cm.
3dB radiator for whip 22 cm.

Ordering code: 118.003.000

2.2 Right angle short antenna

OPANIEL TECHNOLOGIES http://www.opaniel.com

Model: MTX-ACODADA FME F
L= 5 + 2,5 cm
Gain= 0dB

ORDERING CODE: 118.003.025

2.3 Patch Adhesive Antenna

OPANIEL TECHNOLOGIES http://www.opaniel.com
Model: MTX-UT902 – FME F

MTX- UT-902, RG174 3 mts,
GSM DUAL BAND (900 / 1800 MHz) ANTENNA

Patch Antenna
Cable RG174 3 Meters
Gain 2 dB
Frequency: 824-960 MHz, 1770-1880mhZ

ORDERING CODE: **118.003.024**

There is more antenna range of products, you can see in http://www.opaniel.com/products/default.asp?IDP=2

3. CABLES

3.1 SERIAL CABLE

DB9 Male to DB9 Female. 1, 5 meter length available. All pins connected.

Ordering Code: 123.000.000

3.2 USB CABLE

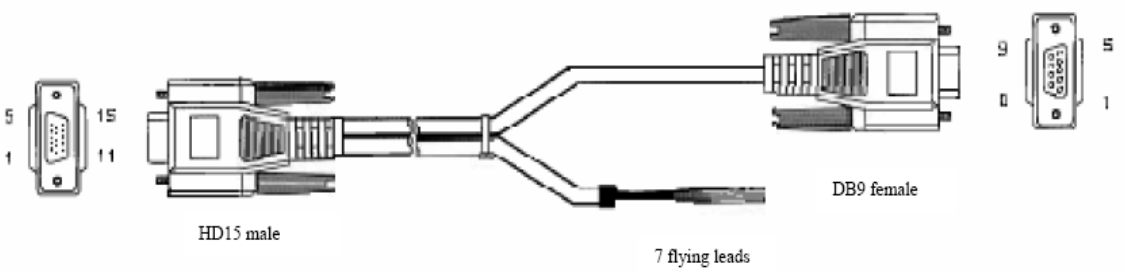
USB-A to Mini USB-B 1,5 meter length cable.

Ordering Code: 120.003.222
REF. USB-AM-MB-B-B-S-2

3.3 Expansion port - RS232 2-way Serial Cable

Modem and System Breakout Cable: 1m lead length
- HD15 male connector Connected to;
  - DB9 female connector (9 signal RS232 serial connection)
  - 7 flying leads

Conductor current rating < 1.5A DC, 26 AWG



Interconnect Table

HD15 male		DB9 female	Flying leads
1	I2CCLK-SPICLK	1	
2	RD1	2	
3	TD1	3	
4	GPIO 1		Black
5	GPIO 3		Brown
6	I2CDAT-SPIDO	6	
7	SPIDI	7	
8	SPICS	8	
9	VEXT		Red
10	DAC_OUT	9	
11	GPIO 2		Orange
12	GPIO 4		Yellow
13	ADC2	4	
14	GND	5	Green
15	ADC 1		Blue

Ordering code: 140.000.994

4. DEVELOPMENT KITs

4.1. SOFTWARE and Documentation for MTX65. (Module TC65 inside)

Manuals
Software CD ROM MTX Terminals

Free of Charge

Ordering Code: 199.801.018

9. CONFORMITY ASSESSMENT

MATRIX ELECTRONICA S.L.
Alejandro Sanchez 109
28019 Madrid
Spain

Declare under our sole responsibility that the products
MTX 63 Terminal V2.0 and MTX 65 Terminal V2.0, containing Cellular Engine Siemens AG engine TC63 (Type S30880-S8160) and TC65 (Type S30880-S8355) respectively to which this declaration relates, are in conformity with the following standards and/or directives:

DIRECTIVES

EC Directive of the European Parliament and of the council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (in short referred to as R&TTE Directive 1999/5/EC).

The product is labeled with the CE conformity mark 89/336/EC Directive on electromagnetic compatibility 73/23/EC Directive on electrical equipment designed for use within certain voltage limits (Low Voltage Directive)

Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

STANDARDS of EUROPEAN TYPE APPROVAL

3GPP TS 51.010-1: Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification

ETSI EN 301 511 V9.0.2: Global System for Mobile communications (GSM); Harmonized standard for mobile stations in the GSM 900 and DCS 1800 bands covering essential requirements under article 3.2 of the R&TTE directive (1999/5/EC) (GSM 13.11 version 7.0.1 Release 1998)

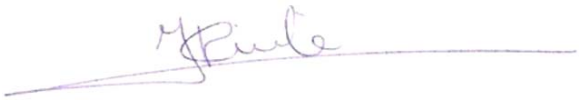
ETSI EN 301 489-1 V1.4.1: Electro Magnetic Compatibility and Radio spectrum Matters (ERM); Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common Technical Requirements

ETSI EN 301 489-7 V1.2.1: Candidate Harmonized European Standard (Telecommunications series) Electro Magnetic Compatibility and Radio spectrum Matters (ERM); Electro Magnetic Compatibility (EMC) standard for radio equipment and services; Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)

IEC/EN 60950-1 (2001): Safety of information technology equipment (2000)

The technical documentation relevant to the above equipment will be held at
MATRIX ELECTRONICA S.L.
Alejandro Sanchez 109
28019 Madrid
Spain

Madrid, 24th September 2007.
Mr. J. Vicente
Managing Board



10. ROHS STATEMENT

The MTX63/65 is compliant with the 2002/95/EC Directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).

11. DISPOSAL OF OLD ELECTRICAL & ELECTRONIC EQUIPMENT (WEEE MARK)

This symbol, applied on our products and/or on its packaging, indicates that this product should not be treated as household waste when you wish to dispose of it. Instead, it should be handed over to an applicable collection point for the recycling of electrical and electronic equipment. By ensuring this product is disposed of correctly, you will help prevent potential negative consequences to the environment and human health, which could otherwise be caused by inappropriate disposal of this product. The recycling of materials will help to conserve natural resources. For more detailed information about the recycling of this product, please contact your local city office, household waste disposal service or the retail store where you purchased this product.

12. ABBREVIATIONS

Abbreviation	Explanations
CBM	Cell Broadcast Message
CBS	Cell Broadcast Service
CSD	Circuit Switched Data
DCE	Data Circuit Terminating Equipment
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi Frequency
EFR	Enhanced Full Rate
EMC	Electro-Magnetic Compatibility
ETSI	European Telecommunication Standards Institute
FR	Full Rate
GPRS	General Packet Radio Service
GSM	Global System for Mobile Communication
HR	Half Rate
HSCSD	High Speed Circuit Switched Data
ITU-T	International Telecommunication Union - Telecommunications Standardization Sector
ME	Mobile Equipment
MO	Mobile Originated
MS	Mobile Station
MT	Mobile Terminated
PDU	Protocol Data Unit
RLP	Radio Link Protocol
RF	Radio Frequency
RTC	Real Time Clock
SIM	Subscriber Identity Module
SMS	Short Message Service
TA	Terminal Adapter
TE	Terminal Equipment
TS	Telecom Services

13. AT COMMAND SUMMARY

The AT standard is a line-oriented command language. AT is an abbreviation of ATtention and it is always used to start sending a command line from the terminal equipment (TE) to the terminal adaptor (TA).
The command line consists of a string of alphanumeric characters. It is sent to the MTX-63/65 to instruct it to perform the commands specified by the characters.

The AT commands listed below are supported by the within the MTX-63/65. The AT command user manual can be downloading from MTX-63/65 web page: www.matrix.es/MTX-TERMINALS. Be aware that not all AT commands will perform valid operations in the MTX-63/65 owing to its modified range of IOs.

AT Command	Description
+++	Switch from data mode to command mode
^SSTN	SAT Notification
A/	Repeat previous command line
AT&C	Set Data Carrier Detect (DCD) Line mode
AT&D	Set circuit Data Terminal Ready (DTR) function mode
AT&F	Set all current parameters to manufacturer defaults
AT&S	Set circuit Data Set Ready (DSR) function mode
AT&V	Display current configuration
AT&W	Stores current configuration to user defined profile
AT+CACM	Accumulated call meter (ACM) reset or query
AT+CALA	Set alarm time
AT+CAMM	Accumulated call meter maximum (ACMmax) set or query
AT+CAOC	Advice of Charge information
AT+CBST	Select bearer service type
AT+CCFC	Call forwarding number and conditions control
AT+CCLK	Real Time Clock
AT+CCUG	Closed User Group
AT+CCWA	Call Waiting
AT+CEER	Extended Error Report
AT+CFUN	Set phone functionality
AT+CGACT	PDP context activate or deactivate
AT+CGANS	Manual response to a network request for PDP context activation
AT+CGATT	GPRS attach or detach
AT+CGAUTO	Automatic response to a network request for PDP context activation
AT+CGDATA	Enter data state
AT+CGDCONT	Define PDP Context
AT+CGEQMIN	3G Quality of Service Profile (Minimum acceptable)
AT+CGEQREQ	3G Quality of Service Profile (Requested)

AT+CGMI	Request manufacturer identification
AT+CGMM	Request model identification
AT+CGMR	Request revision identification of software status
AT+CGPADDR	Show PDP address
AT+CGQMIN	Quality of Service Profile (Minimum acceptable)
AT+CGQREQ	Quality of Service Profile (Requested)
AT+CGREG	GPRS Network Registration Status
AT+CGSMS	Select service for MO SMS messages
AT+CGSN	Request International Mobile Equipment Identity (IMEI)
AT+CHLD	Call Hold and Multiparty
AT+CHUP	Hang up call
AT+CIMI	Request International Mobile Subscriber Identity (IMSI)
AT+CIND	Indicator control
AT+CLCC	List current calls of ME
AT+CLCK	Facility lock
AT+CLIP	Calling Line Identification Presentation
AT+CLIR	Calling line identification restriction
AT+CLVL	Loudspeaker volume level
AT+CMEE	Mobile Equipment Error Message Format
AT+CMER	Mobile Equipment Event Reporting
AT+CMGC	Send an SMS command
AT+CMGD	Delete short message
AT+CMGF	Select SMS message format
AT+CMGL	List SMS messages from preferred store
AT+CMGR	Read SMS messages
AT+CMGS	Send Short Message
AT+CMGW	Write Short Messages to Memory
AT+CMSS	Send short messages from storage
AT+CMUT	Mute control
AT+CMUX	Enter multiplex mode
AT+CNMA	New Message Acknowledgement to ME/TE, only phase 2+
AT+CNMI	New short Message Indication
AT+CNUM	Read own numbers
AT+COLP	Connected Line Identification Presentation
AT+COPN	Read operator names
AT+COPS	Operator Selection
AT+CPAS	Mobile equipment activity status
AT+CPBR	Read from Phonebook
AT+CPBS	Select phonebook memory storage

AT+CPBW	Write into Phonebook
AT+CPIN	PIN Authentication
AT+CPIN2	PIN2 Authentication
AT+CPMS	Preferred SMS message storage
AT+CPOL	Preferred Operator List
AT+CPUC	Price per unit and currency table
AT+CPWD	Change Password
AT+CR	Service reporting control
AT+CRC	Set Cellular Result Codes for incoming call indication
AT+CREG	Network registration
AT+CRLP	Select radio link protocol parameters for originated non- transparent data calls
AT+CRSM	Restricted SIM Access
AT+CSCA	SMS Service Center Address
AT+CSCB	Select Cell Broadcast Message Indication
AT+CSCS	Select TE character set
AT+CSDH	Show SMS text mode parameters
AT+CSMP	Set SMS text Mode Parameters
AT+CSMS	Select Message Service
AT+CSNS	Single Numbering Scheme
AT+CSQ	Signal quality
AT+CSSN	Supplementary service notifications
AT+CUSD	Supplementary service notifications
AT+CXXCID	Display card ID
AT+FCLASS	Fax: Select, read or test service class
AT+FRH	Receive Data Using HDLC Framing
AT+FRM	Receive Data
AT+FRS	Receive Silence
AT+FTH	Transmit Data Using HDLC Framing
AT+FTM	Transmit Data
AT+FTS	Stop Transmission and Wait
AT+GCAP	Request complete TA capabilities list
AT+GMI	Request manufacturer identification
AT+GMM	Request model identification
AT+GMR	Request revision identification of software status
AT+GSN	Request International Mobile Equipment Identity (IMEI)
AT+ICF	Serial Interface Character Framing
AT+IFC	Set Flow Control separately for data directions
AT+ILRR	Set TE-TA local rate reporting
AT+IPR	Set fixed local rate

AT+VTD	Tone duration
AT+VTS	DTMF and tone generation
AT+WS46	Select wireless network
AT\Q	Flow control
AT\V	Set CONNECT result code format
AT^MONI	Monitor idle mode and dedicated mode
AT^MONP	Monitor neighbour cells
AT^SAADC	Show ADC Adjustment Values
AT^SACM	Advice of charge and query of ACM and ACMmax
AT^SAIC	Audio Interface Configuration
AT^SALS	Alternate Line Service
AT^SBC	Battery Charge Control
AT^SBV	Battery/Supply Voltage
AT^SCCNT	Configure Pulse Counter
AT^SCFG	Extended Configuration Settings
AT^SCID	Display SIM card identification number
AT^SCKS	Query SIM and Chip Card Holder Status
AT^SCML	List Concatenated Short Messages from preferred store
AT^SCMR	Read Concatenated Short Messages
AT^SCMS	Send Concatenated Short Messages
AT^SCMW	Write Concatenated Short Messages to Memory
AT^SCNI	List Call Number Information
AT^SCPIN	Pin Configuration
AT^SCPOL	Polling Configuration
AT^SCPORT	Port Configuration
AT^SCSL	Customer SIM Lock
AT^SCTM	Set critical operating temperature presentation mode or query temperature
AT^SDLD	Delete the 'last number redial' memory
AT^SDPORT	Delete a Port Configuration
AT^SFDL	Enter Firmware Download Mode
AT^SFNUR	Select the fixed network user rate
AT^SGACT	Query all PDP context activations
AT^SGAUTH	Set type of authentication for PPP connection
AT^SGCONF	Configuration of GPRS related Parameters
AT^SGIO	Get IO state of a specified pin or port
AT^SHOM	Display Homezone
AT^SHUP	Hang up call(s) indicating a specific GSM04.08 release cause
AT^SICC	Internet Connection Close
AT^SICI	Internet Connection Information

AT^SICO	Internet Connection Open
AT^SICS	Internet Connection Setup Profile
AT^SIND	Extended Indicator Control
AT^SISC	Internet Service Close
AT^SISE	Internet Service Error Report
AT^SISI	Internet Service Information
AT^SISO	Internet Service Open
AT^SISR	Internet Service Read Data
AT^SISS	Internet Service Setup Profile
AT^SISW	Internet Service Write Data
AT^SISX	Internet Service Execution
AT^SJNET	Set Dialup Network Access Parameters
AT^SJOTAP	Over The Air Application Provisioning
AT^SJRA	Run Java Application
AT^SJSEC	Write Binary Java Security Data
AT^SLCC	Siemens defined command to list current calls of ME
AT^SLCD	Display Last Call Duration
AT^SLCK	Facility lock
AT^SLMS	List SMS Memory Storage
AT^SM20	Set M20 compatibility mode
AT^SMGL	List Short Messages from preferred store without setting status to REC READ
AT^SMGO	Set or query SMS overflow presentation mode or query SMS overflow
AT^SMGR	Read short message without setting status to REC READ
AT^SMONC	Cell Monitoring
AT^SMOND	Cell Monitoring
AT^SMONG	GPRS Monitor
AT^SMSO	Switch off mobile station
AT^SNFA	Set or query of microphone attenuation
AT^SNFD	Set audio parameters to manufacturer default values
AT^SNFI	Set microphone path parameters
AT^SNFM	Set microphone audio path and power supply
AT^SNFO	Set audio output (= loudspeaker path) parameter
AT^SNFPT	Set progress tones
AT^SNFS	Select audio hardware set
AT^SNFTTY	Signal TTY/CTM audio mode capability
AT^SNFV	Set loudspeaker volume
AT^SNFW	Write audio setting in non-volatile store
AT^SOPS	Extended Operator Selection

AT^SPBC	Find first matching entry in sorted phonebook
AT^SPBD	Purge phonebook memory storage
AT^SPBG	Display phonebook entries in alphabetical order
AT^SPBS	Step through the selected phonebook alphabetically
AT^SPIC	Display PIN counter
AT^SPIO	General Purpose IO Driver Open/Close
AT^SPLM	Read the PLMN list
AT^SPLR	Read entry from the preferred operators list
AT^SPLW	Write an entry to the preferred operators list
AT^SPWD	Change Password
AT^SRADC	Configure and Read ADC Measurement
AT^SRSA	Remote SIM Access Activation
AT^SRSM	Remote SIM Access Message
AT^SRTC	Ring tone configuration
AT^SSCNT	Start and Stop Pulse Counter
AT^SSCONF	SMS Command Configuration
AT^SSDA	Set SMS Display Availability
AT^SSET	Indicate SIM data ready
AT^SSIO	Set IO state of a specified pin or port
AT^SSMSS	Set Short Message Storage Sequence
AT^SSPI	Serial Protocol Interface
AT^SSTA	SAT Interface Activation
AT^SSTGI	SAT Get Information
AT^SSTR	SAT Response
AT^SSYNC	Configure SYNC Pin
AT^STCD	Display Total Call Duration
AT^STPB	Transmit Parity Bit (for 7E1 and 7O1 only)
AT^SWDAC	Configure and Read PWM Signal for DAC
AT^SXSM	Extended SIM Access
ATA	Answer a call
ATA	Manual response to a network request for PDP context activation
ATD	Mobile originated call to specified number
ATD*98#	Request GPRS IP service
ATD*99#	Request GPRS service
ATD><mem><n>	Mobile originated call using specific memory and index number
ATD><n>	Mobile originated call from active memory using index number
ATD><str>	Mobile originated call from active memory using corresponding field -
ATDI	Mobile originated call to ISDN number
ATDL	Redial last number used

ATE	Enable command echo
ATH	Disconnect existing connection
ATH	Manual rejection of a network request for PDP context activation
ATI	Display product identification information
ATL	Set monitor speaker loudness
ATM	Set monitor speaker mode
ATO	Switch from command mode to data mode / PPP online mode
ATP	Select pulse dialing
ATQ	Set result code presentation mode
ATS0	Set number of rings before automatically answering a call
ATS0	Automatic response to a network request for PDP context activation
ATS10	Set disconnect delay after indicating the absence of data carrier
ATS18	Extended call release report
ATS3	Set command line termination character
ATS4	Set response formatting character
ATS5	Write command line editing character
ATS6	Set pause before blind dialing
ATS7	Set number of seconds to wait for connection completion
ATS8	Set number of seconds to wait for comma dialing modifier
ATT	Select tone dialing
ATV	Set result code format mode
ATX	Set CONNECT result code format and call monitoring
ATZ	Set all current parameters to user defined profile

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